DIET OF *VARANUS CAUDOLINEATUS* (REPTILIA: VARANIDAE)

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ABSTRACT

The diet of museum specimens of *Varanus caudolineatus* is significantly different from those caught on Atley Station in Western Australia. The museum specimens had a much broader range of prey types, (predominantly spiders, grasshoppers and lizards) than those found on Atley Station that had a very high predominance of scorpions and a lower, but significant number of terrestrial spiders in their stomachs and intestines. These data suggest that *V. caudolineatus* at the Atley site essentially forage primarily on the ground rather than in trees as might be expected for an arboreal lizard.

INTRODUCTION

Varanids are generally reported as being carnivorous and opportunistic feeders, eating predominantly invertebrates. However, a few species specialise on prey types that reflect their habitat (Losos and Greene 1988). Diets of many species of varanids have been determined from museum specimens (Pianka 1968, 1969, 1970 a, b, 1971, Greene 1986, Losos and Greene 1988, James *et al.* 1992) or from freshly caught specimens from a diverse range of locations (King and Green 1979, Pianka 1968, 1969, 1970a 1971, 1986). There are few reports of the diet of varanids based on stomach contents collected from a single location (Shine 1986, Thompson in press). Significant ecological information is often inferred from dietary data.

Varanus caudolineatus is an arboreal pygmy goanna that usually takes refuge under loose bark or in the hollows of mulga trees; it is not usually found in spinifex or sand plain habitats (Pianka 1969). Its diet is quite varied and includes mainly grasshoppers, roaches and geckos.

This study reports the stomach contents of 88 Western Australian Museum (WAM) specimens of *V. caudolineatus* and contrasts this data with diet of 33 specimens caught in December 1991 in close proximity on Atley Station, W.A. (119°07'E, 28°25'S), 4 caught in July 1991 North

of Ajana, W.A. (114°45'E, 27°35'S) and the 78 other specimens (largely from the W.A. and S.A. Museum) previously examined by Pianka (1969).

METHODS AND MATERIALS

A ventral incision was made in museum specimens (WAM) and the gut contents removed and identified. Stomach contents or scats were collected from 24 individual *V. caudolineatus* caught in tree hollows and pit traps on Atley Station and four *V. caudolineatus* caught in tree hollows in the area north of Ajana. Nine of the monitors were subsequently recaptured at least five days later on Atley Station and their stomach contents or scats were again collected. Stomach contents were flushed with tepid water, using a technique similar to that reported by Legler and Sullivan (1979). Scats were collected from the calico bags used to temporarily hold *V. caudolineatus* on the Atley and Ajana sites. The stomach contents and scats were stored in a dilute solution of formalin (approximately 10%) for later identification. Neither stomach contents nor scats were collected from seven of the 33 lizards examined from the Atley site. Three of the four lizards from Ajana provided prey items from their stomach.

The Atley Station site contains red loamy soils which supports a vegetation consisting mainly of spinifex (*Triodia sp.*), grasses, mulga (*Acacia sp.*) and gum (*Eucalyptus sp.*) trees. A representative sample of the potential small vertebrate and invertebrate prey items were collected from 60 pit traps (20 litre plastic containers) with 10m drift fences installed on the Atley site.

The analysis of the difference between the stomach contents of museum specimens and those from the Atley site was done using the SPSS/PC discriminant analysis program.

RESULTS

The stomachs of 46 of 88 museum specimens examined were empty. The contents of the remaining 42 stomachs contained predominantly spiders, grasshoppers and lizards (Table 1). Seven of the lizards were identified as geckos, *Gehyra sp.*, and one stomach contained at least two *Gehyra sp.* tails. Most stomachs contained only one item but four contained two or more identifiable items.

Three stomachs of the 4 *V. caudolineatus* from the site north of Ajana contained prey items; these were a spider, a beetle and a cricket (Table 1).

V. caudolineatus from the Atley site fed predominantly on scorpions, followed by a lesser number of large spiders, that were often found in holes in the ground during the day, and lizards (Table 1). Two of the lizards were skinks, one was a juvenile *Menetia greyii* the other was the dismembered parts of a small *Ctenotus schomburgkii*. In addition, three *V. caudolineatus* from the Atley site and one from the site north of Ajana had red gravel in their stomachs. This was probably ingested while they were capturing prey on the ground.

There is a significant difference (chi-square 74.63, df 6, $p<0.0001$) in the gut contents of the museum

Table 1. The number of stomachs (and scats*) with the incidence of prey items in *V. caudolineatus*

	Museum specimens	Pianka 1969	Atley site*	Ajana site
No specimens examined	88	78	33	4
No stomachs empty	46	44	7	1
PREY TYPE				
Centipedes	1	2	1	
Scorpions			17	
Spiders	10	6	7	1
Grasshoppers	8	10	2	
Roaches	3	11		
Moths		1	1	
Larva	4	4	0	
Beetles	1		1	1
Unidentified invertebrate	8	6	0	
Egg sac	1			
Bee		1		
Cricket		1		
Lizards – egg sac		1		
– other parts	9	10	3	
Twigs		2	1	
Red gravel		3	1	

* the contents of lizard scats are included in the data from the Atley site.

specimens we examined and those caught on the Atley Station. 91.2% of the gut contents were classified correctly with the group centroids being 1.95 for the Atley site and –1.13 for the museum specimens.

Potential prey items captured in the 60 pit traps located on the Atley site were placed into three groups, depending on their relative abundance in the traps (Table 2). In addition, *Gehyra variegata* and *Egernia depressa* were found in relatively low number in trees in which *V. caudolineatus* were found.

DISCUSSION

There is a similarity between the stomach contents of the museum specimens we examined and those examined by Pianka (1969), with the exception that Pianka's sample contained a relatively higher number of roaches. This similarity would have been expected.

There is however a significant difference between the diets of *V. caudolineatus* found on the Atley site, and those examined by us in the Western Australian Museum collection. The very high predominance of scorpions and lower, but significant number of terrestrial spiders in the stomachs and intestines of *V. caudolineatus* from the Atley site contrasts with the much broader range of prey types in the museum specimens we examined and in Pianka's (1969)

Table 2. Relative abundance of potential prey items found in pit traps on the Atley site.

Item	Pit trap catch frequency Often caught	Seldom caught	Rarely caught
INSECTA			
Thysanura (silverfish)		*	
Blattodea (roaches)		*	
Isoptera (termites)			*
Mantodea (preying mantids)			*
Orthoptera (grasshoppers)		*	
Phasmatodea (stick insects)			*
Coleoptera (beetles)	*		
Hymenoptera (ants)	*		
ARACHNIDA			
Scorpionida (scorpions)	*		
Araneae (spiders)	*		
CHILOPODA			
Scolopendrida (centipedes)	*		
REPTILIA			
Scincidae (skinks)	*		
Gekkonidae (geckos)		*	
Varanidae (goanna)		*	

samples. In this particular circumstance the stomach contents of specimens coming from a variety of locations [museum and Pianka (1969)] do not necessarily provide a good indication of the diet of the same species at a particular site. This is similar to the situation for *V. mertensi* (Shine 1986).

The different diet of the small monitors at the Atley site probably reflects the food items available and able to be captured and ingested. Centipedes were abundant there, but the adults may be too large or too difficult to subdue. Many of the beetles present there might also have been too large and their exoskeletons too difficult to penetrate for them to become prey for *V. caudolineatus*. The small skinks caught in the pit-traps were predominantly *Ctenotus schomburkii* and *Ctenotus leonhardii*, while the predominant gecko was *Rhynchoedura ornata*. *C. schomburkii* and *R. ornata* appear to be within the suitable prey size range for *V. caudolineatus* to ingest but may be too difficult to locate and capture. *C. leonhardii* is a larger skink and may be too fast and too large for *V. caudolineatus* to capture. *Gehyra variegata*, which was relatively abundant in the stomachs of museum specimens, but was not found in the stomachs of the Atley site monitors, was caught only once

in the pit-traps, but were occasionally found under the bark of trees.

All identifiable species of scorpions and spiders found in the stomachs and scats of these small monitors are ground dwelling invertebrates. In addition, both M. *greyii* and C. *schomburgkii* are both ground dwelling skinks that live around the base of spinifex clumps or in holes in the ground. This supports other behavioural data (Thompson, unpublished) that indicate that *V. caudolineatus* retreat to trees when threatened, to sleep or to observe their surrounds, but essentially forage on the ground.

No *V. caudolineatus* were captured at night in the pit-trapping program on the Atley site, although the ambient temperature at night was often in the mid-to-high 30°C's. Scorpions, and many of the spider species that were preyed-upon, were only found out of their burrows after dark. On two occasions in soft red loamy soils clear tracks of *V. caudolineatus* were found leading to the entrance of scorpion holes, suggesting that these lizards enter burrows in search of prey. The red gravel in the stomachs of monitors may be ingested when they are eating scorpions or spiders captured in burrows.

This study provides further support for the point made by Shine (1986) and Thompson (in press) that the diets of varanids vary significantly with locality and time of the year. Much of the dietary data and the derived ecological information for varanids comes from museum specimens (Losos 1988, Greene 1986, James *et al.* 1992). It would therefore appear inappropriate to draw specific conclusions about the diets of varanids at a particular location from museum specimens or from those caught in other locations. It would be interesting to know however, if there was a relationship between the density of *V. caudolineatus* and the high availability of scorpions at the Atley site or whether this small monitor would feed on other invertebrates in the absence of scorpions.

Contrary to Pianka's (1969) suggestion that V. caudolineatus are not found in spinifex habitats, most of the Atley sites from which V. caudolineatus were collected had patches of spinifex ground cover and a sparse cover of mulga trees.

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